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Intellectual capital efficiency level of Indian banking sector

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ABSTRACT

The purpose of this paper is to investigate the intellectual capital (IC) efficiency of Indian banking sector in utilizing intellectual capital and capital employed to run the organization by using the data envelopment analysis methodology. The authors use three individual components of value added intellectual coefficient as the input variables, and Tobin's Q and return on equity as the output variables. Examining a sample of 35 banks in financial years 2009-2013, findings of this study show that banks listed on the Mumbai stock exchange invest most of their resources in Structural Capital as compared to Human Capital and Physical Capital, and The Jammu & Kashmir Bank Limited, Indian Overseas Bank, HDFC Bank Ltd., State Bank of India, Federal Bank Ltd. and Yes Bank Limited are the most efficient company of all the sample banks, since they have the highest coefficient of intellectual capital super efficiency based on Anderson and Peterson model. The benchmarking analysis of this study may shed light for the managers in banks to benchmark and improve their efficiency in intellectual capital management. The overall average values of Technical efficiency 0.756, Pure technical efficiency 0.984 and Scale efficiency 0.766 suggest that managers of banks are inefficient in scale efficiency intellectual capital due to the technical problem and not managing intellectual capital.

Introduction

The undoubted essences of knowledge economy are knowledge production and knowledge innovation; whereas the exact source of this innovation is intellectual capital, also known as intellect capital and knowledge capital. One of the major issues which were raised among countries, and indeed all economies is how to improve and their intellectual capital. This has led to the adoption of various economic systems and policy options. On the other hand, for the organizations importance about resources is making a shift from tangible resources to the intangible resources is due to the reason that companies and organizations started to use information technology, more dependence on expertise and technical ability and less dependence on manual labour and physical capital (Brinker,2000).In the current era of knowledge economy, business resources comprise of 20% tangible value and 80% intangible value (Rooset a l. 2005).

Therefore, in today's new economy, banks do not primarily invest in fixed assets, but in intangible assets that plays an important role in determining the value of a bank. The present corporate performance measurement system is heavily inclined towards financial and physical aspects of the bank and thus lacks relevant information regarding the performance of the intangible assets or intellectual capital efficiency. As a result, knowledge on the impact of intellectual capital over the corporate performance measurement system or the overall performance of the bank is insufficient. This study gives the valuable insight on the impact of intellectual capital over the financial performance of the selected banks in Mumbai stock exchange and helps to understand the above-mentioned knowledge-gap in Indian perspective.

The efficient performance of banks can helps them to compete and to achieve higher rate of return relative to cost, and at the same time to participate in economic development. Inefficient performance of banks, on the other hand, will lead to hinder economic activities in other sectors such as industry and services as banks are linked directly to the entire economy. Therefore, bank efficiency analysis specially Intellectual Capital Efficiency is an important tool for government, regulators, banks management, stock market, and investors. Several approaches have been used to estimate banks' intellectual capital efficiency. One of these approaches is Data Envelopment Analysis (DEA) which has been used extensively to evaluate the efficiency of banking institutions, education, hospitals and other institutions. Recently, data envelopment analysis (DEA), a non-parametric approach, has become fashionable in the IC management research (e.g. Wu et al., 2006; Lu et al., 2010; Yang and Chen, 2010; Lu and Hung, 2011). In this study, the authors also employ DEA to evaluate the IC efficiency management of Indian bank industry. However, using traditional performance measurement method such as the uni-dimensional financial ratios analysis, which is with subjectivity issue, is not sufficient to analyse the effect of IC on the corporate performance (Feroz et al., 2003). In contrast, DEA allows multiple inputs and multiple outputs to be evaluated concurrently. Furthermore, prior information about the relationship among multiple performance measures is not required in DEA, a technique that accommodate interactions among various performance measures objectively (Hung et al., 2010).

The last few decades have seen a great deal of works on IC measurement but there is no consensus on IC measurement (Uziene, 2010) and they focus on single dimensional evaluation of IC. In this study, the authors used Value Added Intellectual Coefficient (VAIC™) developed by Pulic, (2000) to gauge IC value. VAIC™ has been widely applied in the IC literature (e.g. Tseng and James Goo, 2005; Ting and Lean,2009; Young et al., 2009; Laing et al., 2010; Phusavat et al., 2011; Rehman et al.,2011). Acknowledging the vast literature on the

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application of VAIC^{TM} as an IC indicator; unfortunately, Stahle et al. (2011) has put VAIC^{TM} in a critical analysis and conclude that VAIC^{TM} is an invalid measure of IC. Their arguments may pose considerable caveats on prior VAIC^{TM} research findings. However, VAIC^{TM} is still the most attractive IC measurement given its practical and empirical validity (Zeghal and Maaloul, 2010).

This study focuses on combining VAIC^{TM} with DEA methodology to measure the IC efficiency of Indian banks in increasing corporate value. The authors believe that the criticism on the validity of VAIC^{TM} has minimal impact on this study because the authors treat the individual components of VAIC^{TM}, namely capital employed efficiency(CEE), human capital efficiency(HCE), and structural capital efficiency(SCE), as distinguishable DEA inputs instead of taking the whole VAIC^{TM} as a single input measure. In this study, the authors address such potential bias by employing alternative output measures. Using DEA, the authors are able to identify banks that are on the efficient frontier. Such directions are needed because the DEA benchmarking analysis could help bank managers improve their IC management. Moreover, findings of this study could serve as a reference for managers in making IC investments.

The remaining sections of this study are organized as follows. The next section reviews prior literature. The third section explains the data collection and research methodology. The fourth section presents and discusses the findings. The final section offers conclusions, limitations, and suggestions for further research.

Literature Review

The one who first studied intellectual capital's impact on the banking industry is Pulic, (2000). He measured Australian banks' intellectual capital performance (1993-1995) and Croatian banks' capital performance (1996 - 2000) with VAIC^{TM} model. He found that performance rank and classic accounting rank gave banks significantly different positions. Bontis and his colleagues (2000) examined the three essential components of intellectual capital in Malaysia banking industry. These three components were human resource, capital structure and customer capital in Malaysia's service and non-service industries. This study revealed that capital structure had great influence on these two industries' performance. Although human resource was vital to both industries, it had greater influence on service industry than on non-service industry. Dimitrios G. Mavridis, (2004)studied Japanese banks with the same method and found that the intellectual capital performances among different banks showed significant discrepancies.

Williams, (2004) investigated the relationship between intellectual capital performance and intellectual capital exposure method but did not find a systematic correlation between them except the relevance that intellectual capital exposure decreased significantly when intellectual capital performed at a very high level. Pek Chen Goh, (2005) measured 7 domestic and 3 foreign banks' intellectual capital performance in Malaysia. He found that all the banks' human capital efficiency was relatively higher than their structural capital efficiency; domestic banks' human capital efficiency was generally lower than foreign banks'. Kamath, (2007) measured 98 Indian banks' intellectual capital with VAIC^{TM} model and found that different types of banks performed differently. According to the final results of the model, there were well-performed foreign banks as well as badly-performed ones. Some foreign banks ranked at the top for they made best use of the intellectual capital and financial capital; while some foreign banks with the smallest scale ranked at last for they failed to reach the effective operant level. In the same year, Abdullah Yalama and MetinCoskun, (2007)measured the efficiency of intellectual capital and examined intellectual capital's impact on banks' performance using the database of Istanbul listed banks (1995 - 2004).

Magdi El-Bannany, (2008)targeting on British banking industry (1999-2005), studied the relationships among the three parts of intellectual capital using multiple regression. He found that technological investment, banking efficiency, entrance barrier of banking industry, and investment efficiency had great influence on intellectual capital efficiency. HarjinderSingh Deol, (2009)studied how the usage of intellectual capital affected enterprises' strategic environment. Results showed that after reformation, governmental banks, private banks and foreign banks would choose to use intellectual capital in different ways to deal with the changes in strategic environment. Li Jiaming and Li Fubing, (2005) proved that human capital had position correlation with enterprise's performance which strongly supported the resource-based enterprise theory. Nevertheless, Liu Dinglin (2009) first applied intellectual capital to banking industry and started an exploratory research on the relationship between intellectual capital and enterprise's performance among China's listed commercial banks in 2008. The results showed that the human capital value added coefficient and structural capital value added coefficient both had positive correlation with profitability.

DEA has been extensively implemented in banking industry for many years [Camanho& Dyson, (2005); Chen et al., (2005); Sowlati et al., (2005); Edirisinghe& Zhang, (2007)]. Farkousha et al. (2011) proposed a method to utilize balanced score card (BSC) as a tool for designing performance evaluation indices in banking industry. Khaki et al. (2012) proposed a BSC-DEA technique to rank various decision making units. They considered various financial criteria such as profit-margin, return on assets along with non-financial criteria such as customer satisfaction, advanced services, employee skills to compare the performance of different banks.

Azarbad et al. (2011)presented a BSC-DEA based model to identify strengths, weaknesses, opportunities and threats of a firm. They considered there were various uncertainties associated with all input/output parameters and applied fuzzy numbers to handle the uncertainties. They also considered a real-world case study of banking industry where four major banks were possible candidates of a partnership and implemented the proposed model for the case study. The results have disclosed some of the issues such as weakness of electronic banking, services and resource allocation as part of their infrastructure problems.

Wanke and Barros (2014) measured efficiency in Brazilian banking using a two-stage process where in the first stage, the number of branches and employees were used to attain a certain level of administrative and personnel expenses per year. In the productive efficiency stage, these expenses permitted the consecution of two important net outputs including equity and permanent assets. They applied the network-DEA centralized efficiency model to optimize both stages, simultaneously. They reported that Brazilian banks were heterogeneous, with some concentrating on cost efficiency and others on productive efficiency. In addition, cost efficiency was described by marketing and administration (M&A) as well as size, while productive efficiency was described by M&A and public status. Liu et al. (2009) applied DEA technique to measure the relative efficiencies on a bank in Taiwan and studied the performance and productivity changes when banks implement financial electronic data interchange. They included 18 branches of the performance for implementation of financial electronic data interchange of the overall efficiency, pure technical efficiency, scale efficiency, analysis of reference groups and the potential to improve the value of analysis for different branch performance assessments. The empirical results shown that case bank could adopt the DEA evaluation model as references to upgrade the overall operating performance effectively for creating competitive advantages. Wang et al. (2014) utilized network DEA method to evaluate efficiencies of the Chinese commercial banks.

However, this study did not directly linked intellectual capital to banks' performance, while selected annual profit as the substitute variable. From a thorough view of previous intellectual capital research findings, we can draw an immature conclusion as below:

Although started from the end of 20th century, researches about intellectual have already stretched into various fields. Not only have they touched some knowledge-intensive industries such as IT, but also have stretched to almost all industries. Domestically, however, the study about intellectual capital is still at youth. Intellectual capital, actually, is a relatively new research area with huge potentials. Simultaneously, such studies in India have been concentrating on knowledge-intensive industries. Researches on the banking industry, which has drawn little attention hitherto, are limited in adopting Data Envelopment Analysis (DEA) to study banks' efficiency.

Banking sector is a knowledge intensive sector (Mavridis, 2004; Firer, 2003). Acting as a financial intermediary that channels funds needed by business and household sectors, banks provide essential service in stimulating economic growth (Goh, 2005). Traditionally, the only intangible assets recognized in financial reporting statements are intellectual property, such as patents and trademarks, and acquired items such as goodwill. Although it is still not possible to assign monetary values to most internally generated intangible assets, they nevertheless need to be considered if the process of value creation is to be properly understood. Based on large quantities of previous research findings, this article aims at studying how the intellectual capital affects the listed banks performance in India, which is a novel topic to some extent. This topic not only offers us a challenging attempt, but also gives us room for furthering discussion.

Intellectual Capital(IC)

Intellectual capital is a complex issue that is relatively difficult to conceptualize, define and measure. Research into intellectual capital has multiplied over the past two decades, and the content and significance of the concept have received much discussion in the research literature. On a microeconomic level, 'intellectual capital' refers to the sources of non-physical (added) value for a company or organization: human capital (e.g. skills, experience, training), relational capital (e.g. customer and stakeholder relations, brands, agreements) and structural capital (e.g. company culture, working environment, systems, immaterial rights). By now there is fairly broad agreement about the structure and scope of intellectual capital, and the research literature generally reflects the same distinction of intellectual capital between human capital, structural capital and relational capital. This taxonomical understanding of intellectual capital was first presented by Karl-Erik Sveiby in the mid-1980s and further developed by Edvinsson and Malone (1997), Sullivan (2000)andEdvinsson (2005)). On a macroeconomic level, research into intellectual capital began just after the turn of the millennium, and the measurement methods it used were mainly based on the categorization presented by Edvinsson and Malone and on the indicators developed based on that categorization (e.g. Bontis 2004). Several models based on the formation of company value have likewise been applied in macroeconomic research.

Edvinsson and Malone (1997) argue that the worth of a company lies not in bricks and mortar, but in intangible kind of asset, that is Intellectual Capital, which is hidden behind the company's book values. Roos et al., (1998) express that Intellectual Capital marks the difference between the market value and book value of a company. Edvinsson (2002) states that 1 + 1 = 11 can be realized in firm value, uncovering the hidden values of Intellectual Capital. Marr, (2007) claims that various definitions of IC can be found and there is no single right or wrong definition of IC. Stewart (1991), in his novel report in Fortune Magazine, points out that IC includes patents, processes, management skills, technologies, information about customers and suppliers, and old-fashioned experience, of which when added up together strengthen a company's competitive edge in the marketplace.

In his widely-accepted book, Stewart (1997) defines IC as intellectual material– knowledge, information, intellectual property, experience – that can create wealth. Edvinsson and Malone (1997) delineate IC as the possession of the knowledge, applied experience, organizational technology, customer relationships, and professional skills that give a company competitive edge in the market. Lynn (1998) describes IC as an intangible asset – knowledge that is transformed to some items of value to the organization. The author further maintains that sustainable value added (VA) is created within a company when information is organized into knowledge, and knowledge is transformed into IC. Similarly, Bose and Thomas (2007) conceptualize IC as the knowledge capability of a firm to convert knowledge, skills, and expertise into assets that can become profitable. Hsu and Fang, (2009) summarize IC as the total capabilities, knowledge, culture, strategy, process, intellectual property, and relational networks of a company that create value or competitive advantages and help a company achieve its goals. Stahle et al. (2011) further explain various types of IC models that have been developed and these models are ultimately motivated by the drive to improve overall business performance in the knowledge economy.

In sum, Intellectual Capital refers to the accumulation of all the intangible assets or knowledge that include, but not exhaustive, intellectual property (like patent sand trademarks), intellectual resources (e.g. customer relationship), and intellectual capabilities and competences (for instance, employees' professional skills). When the abovementioned knowledge is transformed efficiently, companies gain competitive advantage and are sustainable, suggesting that IC drives firm performance and value creation (Roos and Roos, 1997; Bontis, 1998). In this paper we focus on VAIC (Value Added Intellectual Capital Coefficient) method developed by a Croatian professor, Ante Pulic (2000, 2003 and 2005). The purpose of this study is to analyse the validity of the VAIC method as an indicator of intellectual capital.

Intellectual Capital Measurement

Bontis, (2001) provides a comparative analysis of various IC measurement methods. His study clearly shows that Skandia led the way in 1994 by developing and issuing the first IC report in addition to traditional financial report in order to convey supplementary information on its effort in measuring knowledge assets. Much research has been devoted to explore new measurement methods (e.g. Brooking, 1996; Stewart, 1997;

Roos et al., 1998; Pulic, 2000). Sveiby (2010) compiles a list of 42 methods for measuring intangibles. The researcher classifies the assorted methods into four measurement approaches, specifically: direct intellectual capital (DIC) methods like Technology Broker (Brooking, 1996), market capitalization methods (MCM) like calculated intangible (Stewart, 1997), return on assets (ROA) methods such as VAIC^{TM} (Pulic, 2000), and scorecard (SC) methods like Skandia Navigatort (Edvinsson and Malone, 1997) and IC-Index (Roos et al., 1998). Each of the above-mentioned approach offers different advantages and disadvantages. Lu et al., (2010) claim that today, there is no best or consensus solution for IC measurement. Among them, VAIC^{TM}, a well known and widely used method (Rehman et al., 2011; Young et al., 2009), is capable of evaluating IC within a firm (Young et al., 2009; Phusavat et al., 2011). VAIC^{TM} is the sum of value creation efficiency of the physical capital and IC (human capital and structural capital). One of the main advantages of VAIC^{TM} is that it highlightsweak areas requiring intervention (Pulic, 2000). Moreover, VAIC^{TM} is superior in terms of its practical validity because the model can be derived using quantitative data from audited financial statements (Clarke et al., 2011; Mehralianet al., 2012). Furthermore, Mehralian et al., (2012) state that VAIC^{TM} is an IC measurement that is characterized by less subjectivity and high objectivity. In this study, the authors employ VAIC^{TM} to estimate the value of IC.

Therefore, many authors and researchers have defined the intellectual capital in many different ways and there is no specific definition is available. Edvinsson& Malone (1997) Customers, computer databases, working processes, trademarks, and copyrights wrap the elements of intellectual capital which includes human capital, structural capital and relational capital. Intellectual includes three components Human capital, Structural capital and social capital. Human capital includes the abilities, skills, experience, specialties of an individual member of the organization and Human capital is the basic source of the innovation (Bounfour, 2002; Brooking, 1996; Edvinsson and Malone, 1997). Structural capital's components are processes, systems, structures and any other intangibles that are owned by the firm but are not included in the balance sheet of the firm (Bounfour, 2002; Brooking, 1996; Edvinsson

Data Envelopment Analysis (DEA)

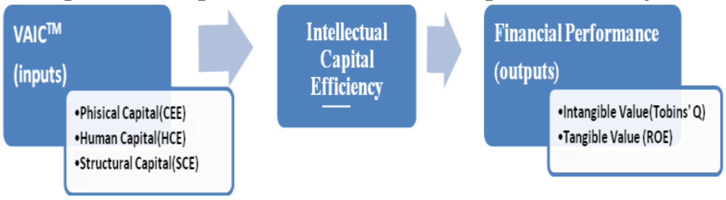
Several studies have utilized Data Envelopment Analysis to measure Intellectual Capital efficiency. Leitner et al. (2005) demonstrate the usefulness of DEA in fulfilling the requirements of evaluating the efficiency of IC quantitatively and comprehensively. Their results indicate that DEA reveals the necessity for IC management. Wu et al. (2006) apply DEA and Malmquist productivity index (MPI) to examine the efficiency of IC management in Taiwanese IC design companies. Using a two-stage DEA model, Lu et al. (2010) measure the capability of Taiwanese fables companies in creating tangible value and intangible value. Yang and Chen (2010) employ DEA and principal component analysis (PCA) to analyse the efficiency of IC management in Taiwanese IC design industry. Following prior studies, the authors also use DEA to measure the process of IC efficiency. This study differs from prior literature in that the authors use VAIC^{TM} to proxy for IC (see Figure 1 for the process of IC efficiency).

Data Collection And Methodology

Data Collection

Sample of this study is restricted to banks in listed on the Mumbai Stock Exchange of India in 2009-2013, whose annual reports are publicly available. Limiting the sample to the banks satisfies the DEA requirement of homogeneous sample(Golany and Roll, (1989). Moreover, the results interpretation with respect to VAIC^{TM} across different sectors is problematic (Stahle et al., 2011). In effect, the industry effects are also eliminated. The original sample consists of 40 bank listed on the Mumbai Stock Exchange. Sample banks with missing input and output variables required to derive DEA scores are eliminated. From the selection criteria, the final sample consists of 35 unique banks.

Figure 1. The process of Intellectual Capital Efficiency



Input Variables: Figure 1 shows that the input variables are madeup of the individual components of VAIC^{TM}, namely CEE, HCE, and SCE. Specifically,CEE is an indicator of VA of capital employed. HCE indicates VA efficiency of human capital, while SCE represents VA efficiency of structural capital. Algebraically, they can be defined as follows, respectively:

$CEE = VA/CA$; $HCE = VA/HC$ and $SCE = SC/VA$

Where, VA is the operating revenues- operating expenses; CA the book value of net assets; HC the total salaries and wages; SC = VA - HC.

Output Variables: Following Lu et al. (2010), the output variables used in this study are the intangible value and tangible value. The authors use Tobin's Q as at year end to proxy for intangible value. Tobin's Q is defined as the ratio of market value to the book value of total assets. Return on equity (ROE), calculated as the ratio of net income to stockholders' equity, is used to proxy for tangible value.

Descriptive Statistics: Table.1 presents the descriptive statistics of both inputs and outputs of sample banks. On average, the SCE investment is the highest, followed by HCE and CEE investments. To further illustrate the input variables, this table shows a comparison between selected banksin Coefficient of Variation (CV) Structural Capital (SCE) which are more than other inputs Human Capital(HCE) and PhysicalCapital(CEE). Table.1 indicates that banksselected on the Mumbai stockexchange have higher mean, *i.e.*,SCE and HCE, but lower average CEE.

Table 1. Descriptive statistics

Variable	Mean	Minimum	Maximum	R	SD	C.V
CEE	0.19	0.07	0.46	0.39	0.10	0.50
HCE	1.55	0.39	5.00	4.61	1.14	0.74
SCE	5.36	1.94	12.06	10.12	2.22	0.41
Tobin's Q	0.13	0.02	0.58	0.56	0.14	1.04
ROE	12.31	4.50	24.80	20.30	5.27	0.43

Source: Own calculations based on annual reports of banking sector Note: n= 35 companies

Research Methodology

This article uses Data Envelopment Analysis (DEA) to study Indian's listed banks' efficiency and derives each bank's technical efficiency (TE) from the banks' annual reports and DEAP software's calculation. Meanwhile, based on previous studies, this article chooses a relatively mature measurement of intellectual capital – Pulic's Value Added Intellectual Coefficient (VAIC) and uses three indexes – Capital Employed Efficiency (CEE), Human Capital Efficiency (HCE) and Structural Capital Efficiency (SCE) – to measure intellectual capital.

DEA, a widely used linear-programming-based composite tool, is developed by Charnes et al. (1978) and extended by Banker et al. (1984). DEA, a mathematical technique comparing multiple inputs and outputs of decision-making units (DMUs) for measuring relative DMUs' efficiency, allows the identification of bench marking. Instead of using merely uni-dimensional ratios and other individual financial variables, IC indicators such as human capital and structural capital can be accommodated so that possible interactions between them can be captured to derive efficiency scores using DEA. Moreover, DEA approach provides added information (Feroz et al., 2003).

Specifically, a DEA study aims to project the inefficient DMUs onto the production frontiers, whereby a researcher can opt for either input-oriented or output-oriented direction. The former refers to the objective to proportionally reduce the input amounts with the output amounts held constant at the present level, and the reverse it is for thelatter. Since bank managers have the discretion to determine the input amounts (IC and physical capital) but not the output amounts (Tobin's Q and ROE), this study applies the input-oriented models.The CCR model proposed by Charnes et al. (1978) is the most basic DEA model. The CCR model is assumed to be under constant returns to scale (CRS) of activities. However, the CRS assumption is not appropriate if not all firms are operating at the optimal scale. The BCC model developed by Banker et al. (1984) overcomes this problem, allowing for variable returns to scale (VRS). Assume there are ***n*** DMUs (DMU_1, DMU_2, …,DMU_n) with ***s*** different outputs and ***m*** different inputs. DMU_j (j = 1, 2, …., n) consumes amount x_{ij} (i = 1, 2, …, m) of input ***i*** to produce amount y_{rj} (r = 1, 2, …, s) of output ***r***. The linear programming in the envelopment form of an input-oriented BCC model to evaluate the efficiency of DMU_0 is shown as follows:

$$Min\ \theta \qquad (1)$$

Subject to:

$$\sum_{j=1}^{n} x_{ij}\lambda_j \le \theta x_{i0} \quad i=1,2,\dots,m; \qquad \sum_{j=1}^{n} y_{rj}\lambda_j \ge y_{r0} \quad i=1,2,\dots,s;$$

$$\sum_{j=1}^{n} \lambda_j = 1 \qquad \lambda_j \ge 0, \quad j=1,2,\dots,n.$$

Where θ is the efficiency score for DMU_0, λ is the weight assigned by DEA. DMU_0 is considered as BCC-efficient if and only if $\theta = 1$. The CCR model differs from the BCC model in which the former iswithout the additional constraint, the convexity condition $\sum_{j=1}^{n} \lambda_j = 1$.

The outcome of the BCC model represents pure technical efficiency (PTE), while that of the CCR model reflects the technical efficiency (TE) of the target DMU. Dividing TE by PTE, the scale efficiency (SE) can be obtained. The SE represents the proportion of inputs that can be further reduced after pure technical inefficiency is eliminated if scale adjustments are possible (Hung and Lu, 2007; Hung et al., 2010). Both TE and PTE values lie between 0 and 1, while SE has a value ≤1. A value of 1 for either TE or PTE means that the target DMU is efficient. If a DMU is efficient under both the CCR and BCC models, it is operating in the most productive scale size or CRS size (Cooper et al., 2006). A DMU with efficiency score <1 is considered inefficient.When the model (1) is used. Usually more than one efficient bank (DMU) is obtained. For ranking efficient companies (9 in CCR model &20banks in BCC model), a model was introduced by Anderson and Peterson in 1993. It should be noted, in this study that this model is applied to efficient companies are also ranked and calculated coefficient of super efficiency which is as shown below. The results will come in the next section in Table.4.

$$Min \quad \theta \qquad (2)$$

Subject to:

$$\sum_{\substack{j=1\\ j\neq o}}^{n} \lambda_j x_{ij} \le \theta x_{io} \quad i=1,2,\dots,m \ ; \quad \sum_{\substack{j=1\\ j\neq o}}^{n} \lambda_j y_{rj} \ge y_{ro} \quad r=1,2,\dots,s \quad \sum_{\substack{j=1\\ j\neq o}}^{n} \lambda_j = 1$$

$$\lambda_j \ge 0 \qquad j=1,2,\dots,n$$

The performance of any DMU, in DEA, is assessed by measuring the key inputs to and outputs from the process under consideration. In this study, the DMUs under assessment are the banks in Mumbai stock exchange. In this paper, global technical efficiency, local pure technical efficiency, super efficiency, and scale efficiency models have been employed to analysis data.

Finding And Discution

Intellectual Capital Efficiency Analysis on the Basis of Standard DEA Models

Table.3 presents the IC efficiency scores of the sample banks. The overall average values of TE (mean TE = 0.756), PTE (mean PTE = 0.984), and SE (mean SE = 0.766) suggest that managers of banks are inefficient in scale efficiency IC due to the technical problemand not managing IC. Therefore, managers should first attempt to improve their scale efficiency, and subsequently management efficiency. The findings show that 42.9per cent of the banks are inefficient in transforming IC into tangible and intangible values. In addition, Table.3 shows that a total of 20banks have (57.1%) an efficiency IC = 1 under pure-technical efficiency, 9 banks (25.7 %) with an efficiency of IC = 1 under scale-efficiency rate and 9banks (25.7%) with an efficiency = 1 under technical efficiency. Thus, under "overall" technical efficiency the estimated IC efficiency scores varied from 0.296 to 1, with a sample mean of 0.756. Of the 35banks involved in the analysis, our results indicate that 9 banks are deemed as efficient while 25banks are rated as inefficient.As noted earlier, this paper also examines the condition with respect to the returns to scale of thebanks. The analysis shows that all of the banks are operating at CRS technology, implying that the inefficient banks reduced in size so as to increase efficiency.

As mentioned earlier, in this paper is examined and measured the contribution of each of the inputs and outputs (variables) that have an impact on the IC efficiency of banks.To achieve this objective, this study uses DEA model to examine factors that significantly influence stocks performance or efficiency of banks. The results of this section is calculated by the use of the efficiency measurement system (EMS) package.The inputs/outputs contribution percentage gives information about the importance of each input/output indicator. This helps to identify which inputs or outputs have been used in determining efficiency. The average values listed in Table.2 indicate a percentage of the overall input and output contributions.

Table 2. The Average weightsinputs & outputs in technical efficiency and Pure-technical efficiency%

Variable / Efficiency	Inputs				Outputs		
	CEE	HCE	SCE	Sum	Tobin's Q	ROE	Sum
TE	40.8	41.4	17.8	100.0	27.7	72.3	100.0
PTE	39.2	23.4	37.4	100.0	52.4	47.6	100.0

According to the results shown in Table.2, the overall contribution values of outputs in the calculation of the efficiency coefficient (technical efficiency) are Tobin's Q27.7% andReturn on equity (ROE) 72.3%. The overall contribution values of outputs in Pure- technical efficiency are Tobin's Q52.4% and

Return on equity (ROE) 47.6%. Based on the results calculated in Table.2, the overall contribution values of inputs in calculation of technical efficiency are Physical Capital (CEE) 40.8%, Human Capital(HCE) 41.4% and Structural Capital (SCE) 17.8%.This index in calculation of pure-technical efficiency are Physical Capital (CEE) 39.2%, Human Capital(HCE) 23.4 % and Structural Capital (SCE) 37.4%.

Table 3. Efficiency scores of the 35 banks selected in Mumbai Stock Exchange

No.	Company Name	Exchange: Ticker	TE	PTE	SE	RTS
1	State Bank of India	(BSE:500112)	1	1	1	crs
2	ICICI Bank Ltd.	(BSE:532174)	1	1	1	crs
3	Punjab National Bank	(BSE:532461)	0.663	0.971	0.683	irs
4	HDFC Bank Ltd.	(BSE:500180)	1	1	1	crs
5	Bank of Baroda	(BSE:532134)	0.674	0.957	0.705	irs
6	Canara Bank Limited	(BSE:532483)	0.525	0.972	0.54	irs
7	IDBI Bank Limited	(BSE:500116)	0.377	0.926	0.408	irs
8	Union Bank of India	(BSE:532477)	0.706	1	0.706	irs
9	Indian Overseas Bank	(BSE:532388)	0.685	1	0.685	irs
10	Oriental Bank of Commerce	(BSE:500315)	0.673	0.954	0.706	irs
11	Allahabad Bank	(BSE:532480)	0.617	0.957	0.645	irs
12	Corporation Bank	(BSE:532179)	0.309	0.929	0.332	irs
13	Indian Bank	(BSE:532814)	0.576	0.963	0.598	irs
14	AXIS Bank Limited	(BSE:532215)	0.783	0.975	0.803	irs
15	Andhra Bank	(BSE:532418)	0.296	1	0.296	irs
16	Bank of Maharashtra	(BSE:532525)	0.543	1	0.543	irs
17	Yes Bank Limited	(BSE:532648)	1	1	1	crs
18	Vijaya Bank Ltd.	(BSE:532401)	0.48	1	0.48	irs
19	State Bank of Travancore	(BSE:532191)	0.494	0.978	0.505	irs
20	State Bank of Bikaner & Jaipur	(BSE:501061)	0.96	1	0.96	irs
21	Punjab and Sind Bank	(BSE:533295)	0.478	1	0.478	irs
22	Federal Bank Ltd.	(BSE:500469)	1	1	1	crs
23	State Bank of Mysore	(BSE:532200)	0.981	1	0.981	irs
24	Karur Vysya Bank	(BSE:590003)	0.669	0.969	0.69	irs
25	The South Indian Bank Ltd.	(BSE:532218)	0.895	0.993	0.901	irs
26	Karnataka Bank Ltd.	(BSE:532652)	0.804	0.972	0.827	irs
27	City Union Bank Ltd.	(BSE:532210)	1	1	1	crs
28	The Lakshmi Vilas Bank Limited	(BSE:534690)	0.993	1	0.993	irs
29	Bank of India	(BSE:532149)	0.798	0.971	0.823	irs
30	Syndicate Bank Limited	(BSE:532276)	1	1	1	crs
31	UCO Bank	(BSE:532505)	0.942	1	0.942	irs
32	IndusInd Bank Limited	(BSE:532187)	1	1	1	crs
33	The Jammu & Kashmir Bank Limited	(BSE:532209)	1	1	1	crs
34	ING Vysya Bank Limited	(BSE:531807)	0.948	1	0.948	irs
35	Dena Bank Ltd.	(BSE:532121)	0.604	0.971	0.622	irs
	Mean		0.756	0.984	0.766	

Source: results of paper

Table.3 presents that based on the CCR model 9 banks and BCCmodel 20banks are relatively efficient (efficiency score = 1). Table.4 shows that the most frequently referred bank is State Bank of India. Closely following State Bank of Indiais Bank of Maharashtra,whichhas 9 times of reference. State Bank of Bikaner & Jaipur, State Bank of Mysore, Syndicate Bank Limited and City Union Bank Ltd.are tracking behind in sequence, respectively.

The nature of returns to scale reported by the software program WIN4DEAP are reproduced in Table.3 Nine banks (State Bank of India, ICICI Bank Ltd., HDFC Bank Ltd., Yes Bank Limited and The Jammu & Kashmir Bank Limited, etc.) show constant-returns-to-scale (CRS), 26 of them show increasing-returns-to-scale (IRS). As seen in Table.3, our results also indicate that the average "pure" technical IC efficiency score for the banks is 98.4% under the assumption of VRS, which is higher than the average score of the "overall" technical IC efficiency under the CRS assumption. On the other hand, the average pure technical efficiency score for banks is more than the average score of scale efficiency 76.6%. This implies that banks inefficiency is attributed to scale inefficiency rather than pure technical inefficiency.

Intellectual Capital Efficiency Analysis on the Basis of AP-DEA Model

Since the basic DEA models (CCR, BCC) can only calculate efficiency coefficient equal to one for efficient banks, we introduced the super-efficiency model as a DEA approach particularly useful for IC evaluation and to estimate IC efficiency coefficients for all banks. In standard DEA, banks are identified as fully efficient and assigned an efficiency score of unity if they lie on the efficient frontier. Inefficient banks are assigned scores of less than unity. Further ranking of the efficient set of banks is possible by computing IC efficiency scores in excess of unity. The super-efficiency score efficient banks is obtainable by calculating its distance to the new frontier whereby this 'extra' or 'additional' efficiency denotes the increment that is permissible in its inputs before it would become inefficient. The consequence of this modification is to allow the scores for efficient units to exceed unity.The results obtained presented in Table.4 conclude that IC efficiency coefficient estimated by applying the supper efficiency(AP) model and using three factors Physical Capital (CEE), Human Capital(HCE) and Structural Capital (SCE).

The results obtained from 24 out of 36banks shows that the IC coefficient of super efficiency is less than the average IC coefficient efficiency (1.1281). Based on the average IC coefficient of efficiency calculated, the banks are classified into four groups, the first group of banks relate to IC coefficients of efficiency that are higher than the average IC efficiency. The three groups of banks relate to IC coefficients that are lower than the average IC coefficient of efficiency. Coefficient of variation (C.V) of the IC coefficient of super efficiency between banks is 24 per cent. While Corporation Bank has the minimum coefficient The Jammu & Kashmir Bank Limited has the highest or the maximum IC coefficient of efficiency.

Table 4. IC Efficiency AP model, Reference set and Ranking

No.	Company Name	Exchange: Ticker	Ranking on the basis of frequency reference set						Ranking on the basis of AP-DEA model			
			Reference set				Frequency	Ranks	IC Efficiency Score	Ranks	Companies Status	Rank in the Group
1	State Bank of India	(BSE:500112)	1				10	1	1.440	4	Group I	4
2	ICICI Bank Ltd.	(BSE:532174)	2				0	7	1.081	13	Group II	2
3	Punjab National Bank	(BSE:532461)	1	16	20		0	20	0.977	26	Group III	7
4	HDFC Bank Ltd.	(BSE:500180)	4				1	6	1.531	3	Group I	3
5	Bank of Baroda	(BSE:532134)	1	16	20	30	0	28	0.945	34	Group IV	6
6	Canara Bank Limited	(BSE:532483)	15	20	34		0	25	0.961	31	Group IV	3
7	IDBI Bank Limited	(BSE:500116)	1	16	23		0	27	0.952	33	Group IV	5
8	Union Bank of India	(BSE:532477)	1	23	30		0	15	0.995	21	Group III	2
9	Indian Overseas Bank	(BSE:532388)	9				0	9	1.632	2	Group I	2
10	Oriental Bank of Commerce	(BSE:500315)	1	16	23		0	21	0.977	27	Group III	8
11	Allahabad Bank	(BSE:532480)	16	20	30		0	22	0.972	28	Group III	9
12	Corporation Bank	(BSE:532179)	16	23			0	29	0.938	35	Group IV	7
13	Indian Bank	(BSE:532814)	1	16	30		0	26	0.960	32	Group IV	4
14	AXIS Bank Limited	(BSE:532215)	4	21	31		0	23	0.971	29	Group IV	1
15	Andhra Bank	(BSE:532418)	15				1	6	1.005	19	Group II	8
16	Bank of Maharashtra	(BSE:532525)	16				9	2	1.059	14	Group II	3
17	Yes Bank Limited	(BSE:532648)	17				0	10	1.346	6	Group I	6
18	Vijaya Bank Ltd.	(BSE:532401)	18				0	13	1.031	17	Group II	6
19	State Bank of Travancore	(BSE:532191)	16	20			0	16	0.992	22	Group III	3
20	State Bank of Bikaner & Jaipur	(BSE:501061)	21				7	3	1.049	15	Group II	4
21	Punjab and Sind Bank	(BSE:533295)	22				1	6	1.181	8	Group I	8
22	Federal Bank Ltd.	(BSE:500469)	23				1	6	1.403	5	Group I	5
23	State Bank of Mysore	(BSE:532200)	24				7	3	1.029	18	Group II	7
24	Karur Vysya Bank	(BSE:590003)	20	27	34		0	24	0.970	30	Group IV	2
25	The South Indian Bank Ltd.	(BSE:532218)	1	20	27	30	0	18	0.981	24	Group III	5
26	Karnataka Bank Ltd.	(BSE:532652)	1	22	23		0	17	0.991	23	Group III	4
27	City Union Bank Ltd.	(BSE:532210)	27				2	5	1.170	9	Group I	9
28	The Lakshmi Vilas Bank Limited	(BSE:534690)	28				0	11	1.083	12	Group II	1
29	Bank of India	(BSE:532149)	1	23	30		0	14	0.999	20	Group III	1
30	Syndicate Bank Limited	(BSE:532276)	30				6	4	1.208	7	Group I	7
31	UCO Bank	(BSE:532505)	31				1	6	1.154	11	Group I	11
32	IndusInd Bank Limited	(BSE:532187)	32				0	12	1.047	16	Group II	5
33	The Jammu & Kashmir Bank Limited	(BSE:532209)	33				0	8	2.311	1	Group I	1
34	ING Vysya Bank Limited	(BSE:531807)	34				2	5	1.162	10	Group I	10
35	Dena Bank Ltd.	(BSE:532121)	1	16	23		0	19	0.980	25	Group III	6

Source: results of paper

1. In the first group of banks IC coefficients of efficiency are between 1.1281 and 2.3112. These banks, arranged in descending order of the coefficients are The Jammu & Kashmir Bank Limited, Indian Overseas Bank, HDFC Bank Ltd, State Bank of India, Federal Bank Ltd., Yes Bank Limited, Syndicate Bank Limited, Punjab and Sind Bank, City Union Bank Ltd, ING Vysya Bank Limited and UCO Bank.
2. In the second group of banks, IC coefficients of efficiency range are between 1 and 1.1281. Eight banks fell in this group. Arranged in descending order these banks are The Lakshmi Vilas Bank Limited, ICICI Bank Ltd, Bank of Maharashtra,

State Bank of Bikaner & Jaipur, IndusInd Bank Limited, Vijaya Bank Ltd, State Bank of Mysore and Andhra Bank.

3. In the third group of banks, IC coefficients of super efficiency range are between 0.9726 and 1. These banks arranged in descending order are Bank of India, Union Bank of India, State Bank of Travancore, Karnataka Bank Ltd, The South Indian Bank Ltd, Dena Bank Ltd, Punjab National Bank, Oriental Bank of Commerce and Allahabad Bank.

4. In the fourth group of banks, IC coefficients of efficiency range are greater than 0 and less than 0.9726. This group has the lowest IC coefficient of efficiency. The IC coefficients of efficiency relate to AXIS Bank Limited, KarurVysya Bank, Canara Bank Limited, Indian Bank, IDBI Bank Limited, Bank of Baroda and Corporation Bankrespectively.

Conclusions

This study examines the efficiency of selected Indianbanks in Intellectual Capital management. The authors use the individual components of value added intellectual coefficient (VAIC^{TM}) as the input variables and corporate values (tangible and intangible values) as the output variables. The authors employ the DEA methodology to evaluate Intellectual Capital efficiency. The findings are summarized as follows: the sample banks invest most of their resources in SCE as compared to HCE and CEE, and The Jammu & Kashmir Bank Limited, Indian Overseas Bank, HDFC Bank Ltd., State Bank of India, Federal Bank Ltd. and Yes Bank Limited are the most efficient company of all the sample banks, since they have the highest coefficient of IC efficiency based on AP model. The benchmarking analysis of this study may shed light for the managers in banks to improve their efficiency in intellectual capital management. In the mean time, the analysis above shows that the descending order of these three variables according to their influence on technical efficiencyis: Human Capital Efficiency (HCE) 41.4 %,Capital Employed Efficiency (CEE) 40.8% and Structural Capital Efficiency (SCE) 17.8%. Thus, banks should not only care about financial products' innovation, but also pay attentiontotheirinputandoutputoptimization.Onlytherationaluseof capitalwill improve the management efficiency. Moreover, this comparison is based on a relatively small sample; hence, it has to be viewed as suggestive only. The authors leave the mentioned issues to future research. The authors also caution the reader that their findings must be interpreted with due regard to their methodological DEA. Although the authors are unaware of any bias, they believe this issue may constitute a future research area.

References

1. Abdullah Yalama and MetinCoskun, (2007) Intellectual Capital Performance of Quoted Banks on The Istanbul Stock Exchange Market[J],Journal of Intellectual Capital, Vol. 8 No. 2:pp. 256-271.
2. Ahangar, R.G. (2011), "The relationship between intellectual capital and financial performance: an empirical investigation in an Iranian company", African Journal of Business Management, Vol. 5 No. 1, pp. 88-95.
3. Azarbad, M., Ekhtiari, M., Sarfaraza, A &Abdi, F. (2011). A framework to select commercial bankpartner using fuzzy BSC-DEA method. Management Science Letters, 1(4), 467-480.
4. Banker, R.D., Charnes, A. and Cooper, W.W. (1984), "Some models for the estimation of technical and scale inefficiencies in data envelopment analysis", Management Science, Vol. 30 No. 9, pp. 1078-1092.
5. Bontis, N. (1998), "Intellectual capital – an exploratory study that develops measures and models", Management Decision, Vol. 36 No. 2, pp. 63-76.
6. Bontis, N. (2001), "Assessing knowledge assets: a review of the models used to measure intellectual capital", International Journal of Management Reviews, Vol. 3 No. 1, pp. 41-60.
7. Bontis, N., 2000, "Assessing knowledge assets: a review of the models used to measure intellectual capital[D], , available at: www.business.mcmaster.ca.
8. Bose, S. and Thomas, K. (2007), "Valuation of intellectual capital in knowledge-based firms: the need for new methods in a changing economic paradigm", Management Decision, Vol. 45 No. 9, pp. 1484-1496.
9. Brooking, A. (1996), Intellectual Capital: Core Asset for the Third Millennium Enterprise, International Thomson Business Press, London.
10. Burgman, R. J., Roos, G., Ballow, J. J. and Thomas, R. J. (2005), "No Longer ‗Out Of Sight, Out Of Mind' Intellectual Capital Approach In Asset Economics Inc. and Accenture LLP, Accenture Institute for High Performance Business‖, Journal of Intellectual Capital, Volume 6, No.4, pp. 588-614.
11. Camanho, A. S., & Dyson, R. G. (2005). Cost efficiency measurement with price uncertainty: a DEAapplication to bank branch assessments. European Journal of Operational Research, 161(2), 432-446.
12. Charnes, A., Cooper, W.W. and Rhodes, E. (1978), "Measuring the efficiency of decision making units", European Journal of Operational Research, Vol. 2 No. 6, pp. 429-444.
13. Chen, X., Skully, M., & Brown, K. (2005). Banking efficiency in China: Application of DEA to pre-andpost-deregulation eras: 1993–2000. China Economic Review, 16(3), 229-245.
14. Clarke, M., Seng, D. and Whiting, R.H. (2011), "Intellectual capital and firm performance inAustralia", Journal of Intellectual Capital, Vol. 12 No. 4, pp. 505-530.
15. Cooper, W.W., Seiford, L.M. and Tone, K. (2006), Introduction to Data Envelopment Analysis and its Uses: With DEA-Solver Software and References, Springer Science.
16. Dimitrios G. Mavridis,The Intellectual Capital Performance of The Japanese Banking Sector[J],Journal of Intellectual Capital, 2004, Vol. 5 No. 1: pp. 92-115.
17. Edirisinghe, N. C. P., & Zhang, X. (2007). Generalized DEA model of fundamental analysis and itsapplication to portfoli o optimization. Journal of Banking & Finance, 31(11), 3311-3335.
18. Edvinsson, L. (2002), Corporate Longitude: What You Need to Know to Navigate the Knowledge Economy, Prentice Hall.
19. Edvinsson, L. and Malone, M.S. (1997), Intellectual Capital: Realizing your Company's True Value by Finding its Hidden Brainpower, Harper Business, New York, NY.
20. Farkousha, S., Najafi, E &Aryanezhad, M. (2011). A BSC-DEA approach to measure the relativeefficiency of service industry: A case study of banking sector. International Journal of IndustrialEngineering Computations, 2(2), 273-282.
21. Feroz, E.H., Kim, S. and Raab, R.L. (2003), "Financial statement analysis: a data envelopment analysis approach", The Journal of the Operational Research Society, Vol. 54 No. 1, pp. 48-58.
22. Firer, S., & Williams, S. M. (2003). Intellectual capital and traditional measures of corporate performance. Journal of Intellectual Capital, 4(3), 348-360. http://dx.doi.org/10.1108/14691930310487806
23. Goh, C.P. (2005). Intellectual capital performance of commercial banks in Malaysia. Journal of intellectual capital, 6(3), 385-396.
24. Golany, B. and Roll, Y. (1989), "An application procedure for DEA", Omega, Vol. 17 No. 3, pp. 237-250.

25. Hao, J. (2010), "Institutional investors, intangible information, and the book-to-market effect", Journal of Financial Economics, Vol. 96 No. 1, pp. 98-126.
26. Harjinder Singh Deol, (2009) Strategic Environment and Intellectual Capital of Indian Banks[J],Journal of Intellectual Capital, ,Vol. 10 No. 1:pp. 109-120.
27. Hsu, Y.H. and Fang, W. (2009), "Intellectual capital and new product development performance: the mediating role of organizational learning capability", Technological Forecasting and Social Change, Vol. 76 No. 5, pp. 664-677.
28. Hung, S.W. and Lu, W.M. (2007), "A comparative study of the performance measurement in global telecom operators", Total Quality Management & Business Excellence, Vol. 18 No. 10, pp. 1117-1132.
29. Hung, S.W., Lu, W.M. and Wang, T.P. (2010), "Benchmarking the operating efficiency of Asia container ports", European Journal of Operational Research, Vol. 203 No. 3, pp. 706-713.
30. Khaki, A., Najafi, S &Rashidi, S. (2012). Improving efficiency of decision making units through BSCDEA technique. Management Science Letters, 2(1), 245-252.
31. Kujansivu, P. (2009), "Is there something wrong with intellectual capital management models?", Knowledge Management Research & Practice, Vol. 7 No. 4, pp. 300-307.
32. Laing, G., Dunn, J. and Hughes-Lucas, S. (2010), "Applying the VAIC™ model to Australian hotels", Journal of Intellectual Capital, Vol. 11 No. 3, pp. 269-283.
33. Leitner, K.-H., Schaffhauser-Linzatti, M., Stowasser, R. and Wagner, K. (2005), "Data envelopment analysis as method for evaluating intellectual capital", Journal of Intellectual Capital, Vol. 6 No. 4, pp. 528-543.
34. Li Jiaming, GuoFubing, (2005), "Positive analysis on Corporate Human Capital and Corporate Performance[J], Market & Population Analysis, Vol.11, No.3：pp.29-36
35. Liu Dinglin，(2009), "Listed Commercial Banks' Intellectual Capital Performance Positive Analysis[J], Modern Corporate Culture， No.26：pp.169-171
36. Liu, Z., Lin, F., & Fang, L. P. (2009), " A study of applying DEA to measure performance on bankimplementing financial electronic data interchange. International Journal of Electronic Business Management, 7(4), 268-277.
37. Lu, W.M. and Hung, S.W. (2011), "Exploring the operating efficiency of technology development programs by an intellectual capital perspective – a case study of Taiwan", Technovation, Vol. 31 No. 8, pp. 374-383.
38. Lu, W.M., Wang, W.K., Tung, W.T. and Lin, F. (2010), "Capability and efficiency of intellectual capital: the case of fabless banks in Taiwan", Expert Systems with Applications, Vol. 37 No. 1, pp. 546-555.
39. Lynn, B.E. (1998), "Performance evaluation in the new economy: bringing the measurement and evaluation of intellectual capital into the management planning and control system", International Journal of Technology Management, Vol. 16 Nos 1-3, pp. 162-176.
40. Magdi El-Bannany, (2008) A Study of Determinants of Intellectual Capital Performance in Banks: The UK Case[J],Journal of Intellectual Capital, , Vol. 9 No. 3:pp. 487-498.
41. Marr, B. (2007), "What is intellectual capital?", in Jaia, L.A. (Ed.), Strategies for Information Technology and Intellectual Capital: Challenges and Opportunities, Information Science Reference.
42. Mavridis,D.G.(2004). The intellectual capital performance of Japanese banking sector. Journal of Intellectual Capital, 5(1), 92-115.
43. Mehralian, G., Rajabzadeh, A., Sadeh, M.R. and Rasekh, H.R. (2012), "Intellectual capital and corporate performance in Iranian pharmaceutical industry", Journal of Intellectual Capital, Vol. 13 No. 1, pp. 138-158.
44. Pek Chen Goh,(2005), "Intellectual Capital Performance of Commercial Banks in Malaysia[J],Journal of Intellectual Capital, ,Vol. 6 No. 3:pp. 385-396.
45. Phusavat, K., Comepa, N., Sitko-Lutek, A. amdOoi, K.-B. (2011), "Interrelationships between intellectual capital and performance: empirical examination", Industrial Management &Data Systems, Vol. 111 No. 6, pp. 810-829.
46. Pulic, A. (2000), "VAIC™ an accounting tool for IC management", International Journal of Technology Management, Vol. 20 Nos 5-8, pp. 702-714.
47. Rehman, W.U., Ilyas, M. and Rehman, H.U. (2011), "Intellectual capital performance and its impact on financial returns of banks: an empirical study from insurance sector of Pakistan", African Journal of Business Management,Vol.5No.20, pp. 8041-8049.
48. Roos, G. and Roos, J. (1997), "Measuring your company's intellectual performance", Long Range Planning, Vol. 30 No. 3, pp. 413-426.
49. Roos, J., Roos, G., Dragonetti, N.C. and Edvinsson, L. (1998), Intellectual Capital: Navigating the New Business Landscape, New York University Press, New York, NY.
50. Saez, P.L., Lopez, J.E.N. and Castro, G.M.D. (2007), "Intellectual capital in knowledege-intensive firms: exploring the concept and main components in Boston's Route 128", in Joia, L.A. (Ed.), Strategies for Information Technology and Intellectual Capital: Challenges and Opportunities, Information Science Reference.
51. Sowlati, T., Paradi, J. C., &Suld, C. (2005). Information systems project prioritization using dataenvelopment analysis. Mathematical and Computer Modelling, 41(11), 1279-1298.
52. Stahle, P., Stahle, S. and Aho, S. (2011), "Valued added intellectual coefficient (VAIC): a critical analysis", Journal of Intellectual Capital, Vol. 12 No. 4, pp. 531-551.
53. Stewart, T.A (1991), "Brainpower intellectual capital is becoming corporate America's most valuable asset and can be its sharpest competitive weapon. The challenge is to find what you have and use it", Fortune, pp. 44-60.
54. Stewart, T.A. (1997), Intellectual Capital: The New Wealth of Organizations, Double Day,New York, NY.
55. Sullivan, P.H. (2000), Value-driven Intellectual Capital: How to Convert Intangible Corporate Assets into Market Value, John Wiley & Sons, Toronto.
56. Sveiby, K.E. (2010), "Methods for measuring intangible assets", available at: www.sveiby.com/articles/IntangibleMethods.htm (accessed 18 May 2012).
57. Ting, I.W.K. and Lean, H.H. (2009), "Intellectual capital performance of financial institutions in Malaysia", Journal of Intellectual Capital, Vol. 10 No. 4, pp. 588-599.
58. Tseng, C.Y. and James Goo, Y.J. (2005), "Intellectual capital and corporate value in an emerging economy: empirical study of Taiwanese manufacturers", R&D Management, Vol. 35 No. 2, pp. 187-201.
59. Uziene, L. (2010), "Model of organization's intellectual capital measurement", Organizacijosintelektinio capital over tinimomodelis, Vol. 21 No. 2, pp. 151-159.

60. Wang, K., Huang, W., Wu, J., & Liu, Y. N. (2014), "Efficiency measures of the Chinese commercial banking system using an additive two-stage DEA. Omega, 44, 5-20.
61. Wanke, P.,& Barros, C. (2014), "Two-stage DEA: An application to major Brazilian banks. Expert Systems with Applications, 41(5), 2337-2344.
62. Williams, S.M., Downsizing, (2004), "Intellectual Capital Performance Anorexia or Enhancement, The Learning Organization, ,Vol. 11 No. 4/5:pp. 368-379.
63. Wu, W.Y., Tsai, H.J., Cheng, K.Y. and Lai, M. (2006), "Assessment of intellectual capital management in Taiwanese IC design banks: using DEA and the Malmquistproductivity index", R&D Management, Vol. 36 No. 5, pp. 531-545.
64. Yang, C. and Chen, T.Y. (2010), "Evaluating the efficiency of intellectual capital management for Taiwan IC design industry", African Journal of Business Management, Vol. 4 No. 15, pp. 3366-3373.
65. Young, C.S., Su, H.Y., Fang, S.C. and Fang, S.R. (2009), "Cross-country comparison of intellectual capital performance of commercial banks in Asian economies", The Service Industries Journal, Vol. 29 No. 11, pp. 1565-1579.
66. Zeghal, D. and Maaloul, A. (2010), "Analysing value added as an indicator of intellectual capital and its consequences on company performance", Journal of Intellectual Capital, Vol. 11 No. 1, pp. 39-60.